The social function of imitation in development

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Abstract

Imitation is a deeply social process. In this paper, I review evidence that children use imitation as a means by which to affiliate with others. For example, children imitate the actions of others more closely when they seek a positive social relationship with them and respond positively to being imitated. Furthermore, children infer something of the relationships between third parties by observing their imitative exchanges. Understanding the social nature of imitation, requires exploring the nature of the social relationships between children and the individuals they imitate. Thus, in addition to discussing children's own goals in imitative situations, I also review the social pressures children experience to imitate in particular ways, learning to conform to the conventions and rituals of their group. In the latter part of this paper, I discuss the extent to which this perspective on imitation can help us to understand broader topics within social development, including the origins of human cultural differences.

Key words: Affiliation, culture, imitation, social motivation, social learning, social norms, Autism Spectrum Disorder.

Introduction

Children acquire the ability to imitate early in life (Carpenter, Akhtar, & Tomasello, 1998; Heyes, 2001; Meltzoff, 1995). From at least the age of 8 months, and perhaps even earlier, children copy the simple actions of others (Barr, Dowden, & Hayne, 1996). Once acquired, the ability to imitate allows children to avoid the time consuming and dangerous process of trial and error learning (Tomasello, 1999). It also allows children to tap into the cultural knowledge of their group members and so benefit from the accumulated knowledge of previous generations (Boyd, Richerson, & Henrich, 2011). It has thus played a central role in the emergence of cumulative culture among human groups (Tennie, Call, & Tomasello, 2009).

The ability to imitate also offers children a means by which to form and maintain relationships with others (Nielsen, 2008; Over & Carpenter, 2012; 2013; Užgiris, 1981; 1984; Yu & Kushnir, 2014). This second function of imitation is referred to as 'social imitation' and it is the primary focus of this paper. I begin by defining social imitation in more detail and discussing the various ways it has been measured by developmental and social psychologists. Following this, I expand upon the significance of social imitation for our understanding of development. I then review the empirical literature on social imitation in children. I summarise three sources of evidence suggesting that imitation serves social functions. First, young children imitate more closely when they have a goal to affiliate (Nielsen & Blank, 2011; Over & Carpenter, 2009). Second, children respond positively to being imitated by other people (Carpenter, Uebel, & Tomasello, 2013; Meltzoff, 1990). Third, children infer something of the relationships between third parties by observing their imitative behaviour (Over & Carpenter, 2014; Powell & Spelke, 2018). In order to fully appreciate the social nature of imitation, it is necessary to understand the social relationship between children and the individuals they imitate (Over & Carpenter, 2012; 2013). In pursuit of this understanding, I next discuss the ways in which models can exert social pressure on children to imitate in particular ways (Kenward, 2013; Haun & Tomasello, 2011). Following

this, I discuss the extent to which the study of Autism Spectrum Disorder can help inform our understanding of the role of social imitation in development (Hobson & Lee, 1999). In the final sections of this paper, I relate the study of social imitation to broader issues in the study of social learning including the origins of human unique forms of culture and cultural differences between groups. I close by outlining what I perceive to be the most important directions for future research in this growing area.

Characterising social imitation

What is social imitation?

Before defining 'social imitation', it is first helpful to define 'imitation'. This task is more controversial than it first appears. Definitions abound in the literature (Carpenter & Call, 2002; Nielsen, 2009). The most straightforward definition, and the one that I will adopt here, is that imitation involves reproducing an action after witnessing it produced by another person (Nielsen, 2009). From this brief definition, it is clear that all imitation is inherently social. By necessity, it involves at least one individual being influenced by another. Furthermore, there are multiple dimensions along which imitation could be considered more or less social. For example, the content of what is copied could relate more strongly to the physical world (e.g., how to use a novel tool) or to the social world (e.g., how to react in a particular social situation) and the relationship between the model and the imitator could be distant or more intimate. What then is social imitation?

'Social imitation' typically refers to the individual's own goals in performing the imitative act. Inspired by the social psychological literature on conformity (Asch, 1955: Deutsch & Gerard, 1956), Užgiris (1981; 1984) drew a distinction between two functions for imitation: instrumental and social. Instrumental imitation refers to copying behaviour geared towards learning a new skill. Social imitation, on the other hand, refers to copying behaviour geared towards achieving social goals. For example, copying another person's actions in an attempt to befriend them.

Perhaps not surprisingly, the distinction between instrumental and social imitation is not as clear-cut as it first appears. Many examples of social imitation also appear to involve learning. Consider, for example, a child learning how to greet someone from observing another person's behaviour. In this case, the child has learned a novel social behaviour that can be used to affiliate with others. Despite the existence of ambiguous cases such as this, the distinction between instrumental and social has proved heuristically useful and references to social imitation have become increasingly prominent in the developmental literature over the last 10 years (Hoehl, Keupp, Schleihauf, McGuigan, Buttelmann, & Whiten, 2019; Krishnan-Barman & Hamilton, 2019; Nielsen, 2009; Over & Carpenter, 2009).

How can social imitation be measured?

Social imitation can be measured in a range of different paradigms. One approach, common within the literature on social imitation in adults, is to investigate the unconscious copying of gestures in naturalistic, or semi-naturalistic settings (Chartrand & Bargh, 1999; Lakin & Chartrand, 2003). In a typical study, a participant interacts with a confederate who, unbeknownst to them, systematically engages in a particular gesture, for example shaking their foot or touching their face. The amount of time participants spend engaging in these different gestures is then measured (Chartrand & Bargh, 1999). Typically, participants show a small but significant tendency to engage in the same behaviour as the confederate. This phenomenon is often referred to as non-conscious mimicry because, when interviewed after the interaction with the confederate, participants claim to be unaware of the nature of the manipulation and/or of any changes in their own behaviour (for a review see Chartrand & van Baaren, 2009).

Another approach commonly employed with adult populations is to measure so-called automatic imitation (Heyes, 2001). In automatic imitation tasks, participants are presented with computer displays of simple gestures, for example a hand opening and closing while performing

an unrelated task, for example opening and closing their own hands in response to different colour cues. The speed with which participants open and close their hands during these displays is measured. Imitation is operationalized as an increase in the speed of responding when participants view the same action (i.e., on compatible trials) compared to when they view the opposing action (i.e., on incompatible trials) (Heyes, 2011). This technique was originally developed in order to understand the cognitive mechanisms underlying imitation but has subsequently been extended in order to investigate the more social aspects of imitation (Leighton, Bird, Orsini, & Heyes, 2010).

The most common method for studying social imitation in children has been to assess the fidelity with which they copy a series of actions demonstrated by a model (Nielsen, 2006; Nielsen, Simcock., & Jenkins, 2008; Over & Carpenter, 2009). In a typical study, children are presented with a box that opens in order to reveal a reward. The experimenter opens the box using a series of unnecessary steps (for example, tapping on the box with a feather or using a tool that is surplus to requirement). The number of irrelevant actions children reproduce when given the opportunity to interact with the box is taken to reflect their level of social motivation within the task (Nielsen et al., 2008; Over & Carpenter, 2009). Although, multiple factors influence the fidelity with which children copy observed actions, there is growing consensus that social motivations are one important factor (Hoehl et al., 2019).

Our capacity to understand the development of social imitation is circumscribed by the tasks that we, as a field, have employed. Whereas the developmental literature has tended to focus on performance in explicit imitation tasks, the adult literature has tended to utilise automatic imitation tasks and those measuring non-conscious mimicry. Recently, important steps have been taken to create tasks that can be used across multiple ages. For example, Van Schaik and Hunnius (2018) have developed a method for measuring nonconscious mimicry in children and Essa, Sebanz and Diesendruck (2019), as well as O'Sullivan, Bijvoet-van den Berg and Caldwell (2018), have measured automatic imitation in

children. In a similar vein, McGuigan (2011) and Horowitz (2003) have measured imitative fidelity in explicit tasks with adults.

There is an implicit assumption in the literature that tasks devised to capture automatic imitation, nonconscious mimicry and overimitation are all measuring the same underlying phenomenon. Certainly, performance in these tasks appears to be influenced by similar social factors. For example, a brief experience of social exclusion influences both nonconscious mimicry in adults (Lakin, Chartrand, & Arkin, 2008) and imitative fidelity in children (Over & Carpenter, 2009; Watson-Jones, Legare, Whitehouse, & Clegg, 2015). However, here we must exercise caution. Social exclusion influences many behaviours, not just imitation (Williams, 2001). The relation between these different tasks thus remains elusive. One valuable direction for future research is to determine whether there are systematic individual differences in the extent of children's imitation across these different types of task.

Why is social imitation important?

Understanding the ways in which children use imitation in order to achieve social goals is an important aspect of understanding how they form and maintain relationships with others (Nadel, 2002; Nielsen, 2009; Over & Carpenter, 2012; 2013; Užgiris, 1981). Imitation has been referred to as a 'social glue' which helps foster close social relationships (Lakin, Jefferis, Cheng, & Chartrand, 2003; Nielsen, 2018). Closely related to this, imitation is one important means by which children learn the social norms and rituals of their community (Kenward, 2012; Keupp, Behne, & Rakoczy, 2013). Adherence to social norms, and participation in group-specific rituals, is crucial to social acceptance (Watson-Jones & Legare, 2016; Nielsen, 2018). Individuals who do not learn these actions appropriately may struggle to be included by their peers and by the community more broadly.

Beyond the role of social imitation in helping explain children's developing social relationships, it may also help to explain the origins of cumulative culture (Haun & Over, 2013). One reason human cultures

accumulate innovations over time, and so become increasingly complex, is that humans imitate the actions of their conspecifics with a high degree of fidelity (Tennie, Call, & Tomasello, 2008). As a result, innovations are maintained within the population and can be improved upon by subsequent generations (Boyd, Richerson, & Henrich, 2011). To the extent that social motivation helps explain the existence of high fidelity imitation, it may also help to explain increasing cultural complexity among human groups (Haun & Over, 2013).

The relationship between imitation and affiliation

There are at least three sources of evidence that imitation serves social functions in development. First, children appear to imitate more closely when they have a goal to affiliate (Nielsen & Blank, 2011; Over & Carpenter, 2009). Second, children respond positively to being imitated by other people (Carpenter et al., 2013; Meltzoff, 1990). Third, children infer something of the relationships between third parties by observing their imitative behaviour (Over & Carpenter, 2014; Powell & Spelke, 2018). I review evidence in favour of each of these claims below.

Children imitate in order to affiliate

The primary claim of literature in this field is that children use imitation in order to achieve social goals (Nielsen, 2009; Over & Carpenter, 2012; Užgiris, 1981; Yu & Kushnir, 2014). If this is the case, then the fidelity of children's imitation ought to vary depending on the nature of the social relationship between the child and the model. Buttelmann, Zmyj and Carpenter (2013) investigated whether 14-month-old German infants were more likely to copy the actions and preferences of an individual who spoke their own language (German) than the actions of an individual who spoke a different language (Russian). Results showed that infants were more likely to copy the actions, but not the preferences, of the individual who spoke their own language (see also Howard, Henderson, Carrazza, & Woodward, 2015).

Manipulating the social relationship between the child and the model in a different way, Nielsen (2006) reasoned that if children imitated for social reasons, then they should be more likely to copy the actions of a model who was warm and friendly than those of a model who acted in a cold and aloof manner. Eighteen-month-old Australian infants were more likely to copy the specific actions of the model when they were warm and friendly. Twenty-four-month-olds showed a somewhat different pattern of responding. These older children tended to copy the specific actions of the model regardless of condition, but were less likely to reproduce the outcome of the actions when the model was cold and aloof. Similar findings have been reported by Nielsen, Simcock and Jenkins (2008) who manipulated whether 24-month-old Australian children interacted with a live, socially responsive model or with a videotaped model who could not provide contingent social interaction. Children were significantly more likely to copy the actions of the live, socially responsive model. In a tightly controlled follow-up, Nielsen et al. compared children's imitation of a model who communicated with them via closed circuit television with children's imitation of a pre-recorded model who could not provide interactive feedback. Replicating the results of the first study, children were significantly more likely to copy the precise actions of the socially interactive model.

These seminal studies demonstrated that, contrary to the leading perspective at time (Lyons, Young & Keil, 2007; Horner & Whiten, 2005), the fidelity of children's imitation is influenced by social factors. However, from these studies alone, it is unclear whether the changes in children's imitation were driven by an increased liking of the model or by a goal to be liked by the model. Indeed, it is possible that both factors were in play. One means by which to start to tease apart these competing explanations is to utilise paradigms in which the behaviour of the model is held constant and children's own goals in the situation are manipulated. Over & Carpenter (2009) manipulated five-year-old German children's own affiliative motivation within an imitative setting by showing them videos that primed the idea of social exclusion. In these videos, one shape appeared to be

excluded from a group of other shapes. We know from previous research with adults that experiencing ostracism increases a range of affiliative behaviours (Lakin et al., 2008; Williams, 2001). Over and Carpenter reasoned, therefore, that if children imitate in order to affiliate with a model, then they should copy the specific actions of the model more closely after being primed with ostracism than after having been primed with closely matched control videos that did not depict social exclusion. In line with this hypothesis, children imitated significantly more of the model's actions in the ostracism condition than in the control condition. This result has subsequently been replicated and extended by Watson Jones, Legare, Whitehouse and Clegg (2014) who found that 3- to 6-year-old American children were more likely to copy the actions of a model in two different tasks following priming with social exclusion.

Thus far, we have discussed situations in which children use imitation in order to build positive, affiliate relationships. Much of the focus of research in this area has focused on the ways in which imitation provides a "social glue" of relationships (Lakin et al., 2003). However, social imitation can also be used to achieve more self-serving, or even Machiavellian ends. For example, within social psychology is well known that sales staff often use imitation in order to encourage potential customers to buy their wares (Chartrand & van Baaren, 2009). Developmental research suggests that children too can use imitation in the service of persuasion. Thelen et al. (1980) offered 10-year-old American children the opportunity to imitate a peer. Prior to the imitative interaction, they manipulated how children perceived their relationship with this peer. In one condition, children were told that they would later have to convince a social partner to eat some unappealing looking cookies. Children in a control condition were simply told that they would later 'do something with the cookies.' Children who believed that they would later have to convince their partner to eat the unappealing cookies imitated significantly more of their social partner's actions than did children in the control condition. Thus, although children can use imitation as a sort of

'social glue' to form positive relationships with others, they can also use it for more explicitly strategic purposes.

Children respond positively to being imitated

If imitation serves social functions in development, then being imitated ought to exert a measurable influence over children's behaviour. Research with adults has shown that when participants' gestures are mimicked by a confederate, they are subsequently more likely to seek out social interaction and to engage in positive social behaviors such as helping (Ashton-James, van Baaren, Chartrand, Decety, & Karremans, 2007; van Baaren, Holland, Kawakami, & van Knippenberg, 2004). One of the earliest developmental studies of the effects of being imitated on young children's behaviour was conducted by Meltzoff (1990). He found that 14-month-old American infants showed a tendency to look longer at individuals who imitated their behaviour and smiled more at these individuals as well. This work was later extended by Carpenter, et al. (2013) who measured the influence of being imitated on infants' helping behaviour. Carpenter et al. engaged 18-month-old German infants in a social interaction in which an experimenter either imitated their actions or engaged in equally friendly behaviours that were contingent on the infants' behaviour but non-imitative in nature. Infants' tendency to help the experimenter, for example by picking up some objects she had dropped, was then measured. Results showed that infants were significantly more likely to help the experimenter when she had imitated them. Interestingly, infants were also more likely to help a stranger after being imitated, perhaps suggesting an increase in general prosocial responding rather than an effect limited to the specific relationship with the experimenter.

In further work, Over et al. (2013) investigated the social consequences of being imitated in older children. In this study, five- and six-year-old German children interacted with two experimenters. One experimenter consistently imitated their choices in a novel game, while a second experimenter consistently made independent choices. In a subsequent test phase, children were significantly more likely to trust the

factual claims of the experimenter who had imitated them and were more likely to endorse this experimenter's preferences as well.

Children infer third party relationships from observing imitation

If imitation varies systematically with the quality of social relationships, then it follows that children may be able to use imitative exchanges they observe as one source of evidence to infer the relationships between third parties**.** Over and Carpenter (2014) measured whether 4- and 5-year-old German children would infer that an adult liked someone she imitated more than someone she chose not to imitate. Children watched a video in which a central character imitated the actions and object choices of one individual and attended to but chose not to imitate the actions and object choices of another individual. When asked who the central character liked more, 5-year-old children reported that she liked the person she had imitated. Furthermore, many of them were able to explain their choice by explicit reference to the character's imitative behaviour, suggesting they were consciously aware of the connection between imitation and liking.

In a second study, Over and Carpenter (2014) investigated whether there are sometimes reputational costs to imitating another person. In this study, one individual consistently imitated the actions of another. At test, children were asked which individual was higher status, the person who imitated or the person who was imitated. Five-year-old children indicated that the person who *was* imitated was higher in status. This study suggests that even though there are many advantages to imitating others (including the opportunity to form social bonds and acquire new skills) there can be reputational costs as well.

In more recent work, Powell and Spelke (2018) investigated whether even infants are able to infer something of third party relations from watching others imitate. In their study, 4- and 5-month-old American infants observed a video in which novel agents interacted with each other in varying ways including copying each other's movements and sounds. At test, infants expected characters who engaged in imitation to approach and affiliate with the agents they had copied. Interestingly, infants did not

expect the targets of imitation to approach the characters who had imitated them, suggesting an important boundary condition to the types of inferences infants make in these situations. In closely related research, Liberman, Kinzler, & Woodward (2018) presented 16-month-old infants with demonstrations in which two models either used the same action to turn on a light or contrasting actions. Infants' expectations about the nature of the relationship between the two models was then measured in a looking time paradigm. Infants were surprised when two models who had used different actions appeared to be friends in a subsequent interaction. These results provide converging evidence that infants form some expectations about the nature of third party relationships from observing the extent of others' imitation.

Is social imitation sometimes communicative?

Once we accept that imitation serves social functions in development, another important question presents itself. Developmental and social psychologists have discussed whether or not social imitation is communicative. On the one hand, social imitation could be driven by a private desire to be like a social partner without any desire to communicate that goal to the model. In support of this view, social psychological research has shown that adults sometimes imitate the gestures of a model even when that model is presented on video (Lakin & Chartrand, 2003). An alternative view is that imitation is at least sometimes used as a means by which to communicate with a model, for example to convey the message "I am like you" (Bavelas, Black, Chovil, Lemery, & Mullett, 1988).

Suggestive evidence that young children's imitation is sometimes communicative has been provided by Nadel (2002). Nadel reports that French children between the ages of 18–30 months regularly use imitation in naturalistic interactions with their peers. At times, imitation appears to take the form of a 'conversational' exchange with repeated turn taking. For example, one child may pick up an object, similar to one she has been using herself, and offer it to a peer. The peer may then take the object and start

imitating the first child's object use. In other exchanges, a child may start imitating a peer without any prompting from the peer. The peer may then notice that she is being imitated and propose new actions for the first child to copy.

Experimental research into the claim that social imitation can sometimes be communicative has been conducted by Nielsen and Blank (2011). Nielsen and Blank presented 4- and 5-year-old Australian children with two experimenters each of whom retrieved toys from a novel box. Whereas one model used a series of irrelevant steps in order to retrieve the toy, the other used only causally necessary actions. After both experimenters had demonstrated their actions, one of them left the room and the remaining adult handed the toy to the child. Results showed that children reproduced the irrelevant actions more often when the experimenter who had demonstrated those actions stayed in the room. In closely related research, Atlinok, Over and Carpenter (submitted) measured whether children make an effort to ensure that a model observes their imitation. In their studies, an experimenter demonstrated an action, passed the target object to the child, and then sat down behind a screen. In one condition, the screen separating the child and the experimenter was opaque meaning that the child would need to raise their arms in order for the experimenter to observe their imitation. In the other condition, the centre of the screen had been removed meaning that the experimenter could observe the child's imitation without any additional effort on the part of the child. Children were significantly more likely to raise their arms above the screen as they imitated when the screen was opaque, suggesting that they went to some effort to ensure that the experimenter could observe their imitation.

A more challenge question is to understand what message or messages children seek to convey through imitation. One possibility is that children convey basic messages such as 'I am paying attention to you' through matching the actions of their social partners. Another possibility is that children seek to communicate the message 'I am like you' (Over & Carpenter, 2012; 2013). An additional open question relates to who

children seek to communicate to through their imitation. Children may use imitation not only to communicate with a model but also to communicate with bystanders. For example, to convey the message "I am like her". Understanding the nuances in children's communicative imitation remains an important topic for future research.

Imitation and perceived social pressure

Thus far we have considered how children's affiliative motives influence their imitative behaviour. Affiliative motivations can interact with other aspects of the social situation that influence the fidelity with which children copy. The nature of the social interaction in which imitation is embedded can lead children to feel pressure to imitate in particular ways (Over & Carpenter, 2012; 2013).

Adherence to norms

One way in which children may experience social pressure to imitate is when they believe the actions they observe represent social norms. Social norms specify how individuals within a community typically act, but also how they ought to act – what behaviours are permitted and obligated within the group (Cialdini, 2001; Kenward, 2013; Rakoczy, Warneken, & Tomasello, 2008; Schmidt, Rakoczy, & Tomasello, 2019). When children fail to follow the norms of their group, this may lead to censure or even to rejection (Over & Carpenter, 2009; Nielsen, 2018).

When children imitate the actions of a model closely, one motivation could be to adhere to perceived social norms. Kenward (2012) investigated why children sometimes overimitate the actions of others. Rather than measuring children's imitation directly, he focused on how they responded to the imitative behaviour of a puppet. Kenward presented 3- and 5-year-old Swedish children with a demonstration in which a puppet observed an adult demonstrate how to use an object using an unnecessary action. In the crucial condition, the puppet imitated the model's action but omitted the unnecessary step. Children protested against the puppet's omission of the unnecessary action. Presumably they

did so because they inferred that the puppet ought to reproduce all of the demonstrated actions. These results were later replicated by Keupp, et al. (2013). In related research, Hermann, Legare, Harris and Whitehouse (2013) investigated whether framing an action as conventional increases 3- to 6-year-old American children's imitative fidelity. Hermann et al. found that children imitated more faithfully when they were told that the action represented a social convention. Similar results were later found by Clay, Over & Tennie (2018) who tested 4- to 6-year-old British children and found that the older children in their sample were more likely to copy the modelled actions faithfully when these actions had been framed as a social convention.

Although following social norms represents one social motivation for children's imitation, it is unlikely that all social imitation is normative. Children regularly copy actions that do not take the form of social norms. For example, van Schaik and Hunnius (2018) have shown that five-year-old Dutch children sometimes imitate subtle gestures such as touching their face when a model touches their face. Rather, it seems that the desire to follow social norms is one manifestation of broader social-affiliative motivations for imitation.

The influence of multiple models

Pressure to act in accordance with perceived social norms can also come from the number of models present. Haun and Tomasello (2011) studied children's tendency to conform to the norms of the group, a behaviour closely related to imitation. In a child friendly version of the Asch (1955) paradigm, Haun and Tomasello measured whether children copied the opinions of a group. Four-year-old German children were placed in a room with three of their peers and asked to estimate the relative size of different animal pictures. On test trials, the three peers gave an answer which was, from the child's perspective, incorrect. Following this, children were required to give their own answer. Results showed that children conformed to the majority's incorrect judgment on approximately 40% of trials. The social pressure children experienced within this

situation is underscored by a second experiment which compared children's responses when they were given in public versus in private. When children were allowed to give their responses in private (pointing to their answer covertly rather than expressing it verbally so that everyone could hear) conformity dropped to almost zero (see Corriveau, Fusaro, & Harris, 2009, and Fusaro & Harris, 2008, for related findings).

Social imitation in Autism Spectrum Disorder

Researchers seeking to understand the role of social motivation in imitation have sought to draw conclusions from the study of Autism Spectrum Disorder (ASD). Much of this work is based on the assumption that individuals with ASD demonstrate lower levels of social motivation than do neurotypical individuals (Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012). This has led researchers to hypothesise that, if imitation is motivated by social goals, then children with ASD may copy the actions of a model less faithfully than do typically developing children. The extent to which this hypothesis is supported by empirical data, however, remains somewhat controversial.

Early research by Hobson and Lee (1999) measured the extent to which 9- to 18-year-old British participants copied the style with which a model performed an action. The experimenter demonstrated a series of actions of objects but varied the style with which they performed them, for example, harshly or softly. Hobson and Lee found that children with ASD were less likely to copy the particular style with which the model performed the actions than were children in the control condition. This research was later replicated by Hobson and Hobson (2008) who found that 5- to 14-year-old British children with ASD were less likely to copy stylistic elements of actions they observed than were children with developmental delay. More recently, these results have been conceptually replicated by Marsh, Pearson, Ropar and Hamilton (2013) who measured the performance of 4- to 14-year-old British children with ASD and typically developing children within an overimitation paradigm. In this study, the model demonstrated how to operate a novel object using a

series of irrelevant actions. Marsh and colleagues found that children with ASD copied significantly fewer of the irrelevant actions than did typically developing children.

However, contrasting results have been reported by Nielsen, Slaughter and Dissanayake (2013). Nielsen et al. tested 4- to 8-year-old Australian children with ASD and typically developing children within a standard overimitation paradigm. In this study, children with ASD overimitated to a similar extent as did typically developing children. In closely related research, Nielsen and Hudry (2010) found similar levels of overimitation in children with ASD and children with Down syndrome.

Heterogeneity within the diagnosis of ASD is one possible reason for these discrepant results. There is increasing appreciation within the literature that individuals with a diagnosis of ASD present with a range of social abilities and motivations (Georgiades, Szatmari, & Boyle, 2013). Similarly, there are multiple influences on children's tendency to overimitate (Hoehl et al., 2019). It may be that some, but not all, children with ASD differ from typically developing children in their tendency to engage in social imitation. Understanding the nuances of social motivation in ASD and how it is relates to imitative behaviour remains a substantial challenge and an important priority for future research.

Cross cultural perspectives on social imitation

The overwhelming majority of research on social imitation in children and adults has been conducted within Western cultures. However, in order to truly understand the phenomenon, it is necessary to catalogue the extent and nature of the variation in the behaviour across diverse cultural communities. Understanding cultural variation in social imitation can help inform our understanding of its origins. In particular, whether it might represent an adaptation for social interaction (Nielsen & Tomaselli, 2010). If social imitation has evolved, then we may expect to observe similar levels of imitation across diverse cultural contexts even where socialisation practices vary substantially (Nielsen & Tomaselli, 2010). If, on the other hand, children learn to use imitation in order to achieve social

goals, then we might expect to observe substantial cross cultural variation in the extent of social imitation and in the types of social situations in which children imitate (Heyes, 2018).

Some research does suggest that the tendency to overimitate is present across diverse cultural groups. For example, Nielsen and Tomaselli (2010) investigated the tendency to overimitate in 2- to 13-year-old children from Australia and from Kalahari Bushmen communities in South Africa. Children from both communities copied the irrelevant actions of the model. Replicating and extending this initial result, Nielsen, Mushin, Tomaselli, & Whiten (2014) investigated overimitation in 3- to 6-year old urban Australian children, Aboriginal Australian children, and Kalahari bushmen children from South Africa. Nielsen and colleagues found that children from all three communities overimitated to a similar extent. In related research, Stengelin, Hepach and Haun (2019) have suggested that overimitation is modulated by similar social factors in multiple cultures. Stengelin and colleagues investigated 3- to 8-year-old children's tendency to overimitate in three communities – the Hai||om and Ovambo (both living in Namibia) and Germany. Stengelin et al found that children from all three communities imitated more of the model's actions when the model was present to observe their imitation compared to when they were absent. This suggests that children from all three communities were influenced by social goals when deciding what to imitate. Nielsen and Tomaselli (2010) suggest that these findings imply that overimitation could be a universal human trait. However, caution is always required when interpreting a lack of differences between groups.

Other research suggests that there is cultural variation in the extent to which children from different communities overimitate. Clegg and Legare (2016) investigated overimitation in 6- to 8-year-old children from Vanuatu and from the USA. They found some evidence for cross cultural convergence – children from both communities overimitated more when the task was framed as conventional than when it was framed as instrumental. However, children from Vanuatu overimitated more than did children from the US when the task was framed as instrumental. The

authors speculate that this cultural difference could be the product of increased cultural emphasis on conformity in Vanuatu as well as a greater reliance on observational learning in that culture. In related research with different communities, Berl and Hewlett (2015) investigated overimitation among 4- to 7-year-old Aka children from a hunter-gatherer community and Ngandu children from a farming community in the Central African Republic and Western children from the USA. They found that children from Aka communities overimitated less than did children from the Ngandu and Western communities. Berl and Hewlett (2015) argue that these cultural differences could be driven by a reduced emphasis on formal teaching among the Aka.

Other research has started to investigate how cultural differences along the dimension of independence-interdependence may influence imitative behaviour. DiYanni et al (2015) compared imitation in 3- to 5-year-old Chinese American children and Caucasian American children. They found that Chinese American children imitated more than did Caucasian American children after observing a consensus of models all demonstrating the same action. This research was later replicated and extended by Corriveau et al. (2017) who also found that Chinese American children imitated more than did Caucasian American children after observing a consensus. Furthermore, Chinese American children were more likely to teach the inefficient method modelled by the consensus to another child than were Caucasian American children. In related research, Corriveau et al. (2013) showed that Asian American children were more likely to conform to the claims made by a unanimous group when giving their answers in public than were Caucasian American children. These data demonstrating extensive cross cultural variability in social imitation do not rule out the possibility of an innate contribution to social imitation. However, they do suggest a substantial role for learning in determining how children use imitation in social settings.

Social imitation in other species

Other researchers have addressed the question of whether social imitation is unique to humans. A range of non-human animals can be trained to imitate the actions of their conspecifics (Heyes, 2001). What is less clear is whether animals use imitation as a means by which to achieve social goals (Haun & Over, 2013; Nielsen, 2009). This debate is important because social imitation is hypothesised to play a role in explaining human unique forms of culture (Haun & Over, 2013; Nielsen, 2009). If this is the case, then we might expect human children but not other primates to imitate in order to achieve social goals.

In the comparative literature, the social function of imitation has been most commonly studied in chimpanzees, our closing living primate relative. To date, the majority of evidence suggests that although chimpanzees sometimes imitate the actions of both their conspecifics and human demonstrators, they do not imitate in order to achieve social goals (Luncz, Sirianni, Mundry, & Boesch, 2018; Horner & Whiten, 2005; Van Leeuwen, Cronin and Haun, 2014). Most relevant in this context are data suggesting that chimpanzees do not overimitate. In one study comparing the imitative behaviour of human children and chimpanzees, Nagel, Olguin, and Tomasello (1993) presented chimpanzees and 2-year-old American children with a rake-like tool and a desirable but out-of-reach object. In one condition, a human demonstrator used the rake to drag the reward within reach but did so using an inefficient method. In the other condition, the human demonstrator used the rake efficiently. Children copied the model's action even when it was inefficient. Chimpanzees, on the other hand, used the more efficient method regardless of which demonstration they observed. Similar results were later found by Horner and Whiten (2005) who presented 3- to 4-year-old British children and chimpanzees with a model who retrieved a reward from a puzzle box using a series of irrelevant steps. In one condition, the puzzle box was opaque meaning it was not clear which actions were causally necessary for retrieving the reward and which were not. In the other condition, the box was transparent making the irrelevant nature of some of the demonstrated

actions clear. Children copied the causally irrelevant actions of the model in both conditions. Chimpanzees, on the other hand, copied the models actions more often in the opaque condition than in the transparent condition. One possible explanation for these results is that whereas children are socially motivated to imitate a human model, chimpanzees are not.

In related research, Haun, Rekers and Tomasello (2014) investigated how social factors influence the copying behaviour of chimpanzees, orangutans and 2-year-old German children. Rather than using human demonstrators, Haun et al. used conspecific demonstrators, thus maximising the probability that participants would seek a social connection with them. In the first part of the study, participants from the three species individually acquired a problem-solving strategy. At test, participants then watched several conspecific peers demonstrate an alternative strategy. Whereas children switched to the new socially demonstrated strategy approximately 50% of the time, apes rarely changed their strategy to the majority's demonstration. A further study investigating the influence of social motivation on children's tendency to switch to the modelled actions showed that children were more likely to switch to the method demonstrated by their peers when their peers remained present to observe them compared to when they were absent.

Clay and Tennie (2018) took another approach to investigating social imitation in non-human primates. Rather than comparing overimitation in children and chimpanzees, they compared overimitation in children and bonobos. Bonobos outperform chimpanzees on some social cognitive tasks (Hermann, Hare, Call, & Tomasello, 2010) and show higher levels of social tolerance (Hare & Kwentuensa, 2010) and orienting to social information (Kano, Hirata, & Call, 2015). As a result, Clay and Tennie reasoned that bonobos may be more likely to show overimitation than their close relations, chimpanzees. Whereas the 3- to 5-year-old British children in their study readily copied the causally irrelevant actions of the model, not a single bonobo did so.

Thus, although other great apes are clearly motivated to spend time with their conspecifics and devote considerable effort to maintaining social relationships through activities such as grooming, it appears they do not use imitation as a means by which to affiliate with each other (Clay & Tennie, 2018).

However, some evidence suggests that there may be a social side to imitation in some non-human primates. Paukner, Suomi, Visalberghi and Ferrari (2009) tested whether capuchin monkeys prefer humans who imitate them. Similar to results with human infants (Meltzoff, 1990; Carpenter et al., 2008), Paukner et al. found that capuchins looked longer at an individual who imitated them, spent more time in proximity to that individual and were more likely to exchange tokens with them as well. If replicated in future studies, these data might point towards a social function for imitation in at least some non-human primates.

One outstanding question is whether other social animals, beyond primates, imitate for social reasons. Although primates are humans' closest living relatives, other species may have greater cause to imitate each other's actions for social reasons. Investigating the possibility of social imitation in pair-bonding birds, for example, could be an interesting direction for future research.

Future directions

This review raises a number of interesting questions for future research. One important avenue for further investigation is to understand how different forms of social imitation relate to each other. Previous research has shown that it is possible to measure nonconscious mimicry and automatic imitation in children, as well as overimitation (Essa et al., in press; Lyons et al., 2007; van Schaik & Hunnius, 2018). Furthermore, these different forms of imitation appear to be influenced by similar social factors (Over & Carpenter, 2009; Lakin et al., 2008). However, it is not yet clear whether these different imitation tasks tap into the same underlying mechanism. Individual differences research could help address this question. For example, future studies could investigate whether children

who show a strong tendency to overimitate the irrelevant actions of a model also show larger automatic imitation effects and a greater tendency to subconsciously imitate the actions of others. Assuming there is a general tendency to imitate more in social settings that manifests itself across different tasks, then this tendency could be correlated with other measures of social interest and interaction in order to understand which aspects of social motivation most strongly predict imitative fidelity (Yu & Kushnir, 2019,). One interesting question in this domain is whether children high in social motivation are consistently more imitative or whether they are more sensitive to the particular context when deciding whether to imitate.

Another important direction for future research is to understand the developmental trajectory of social imitation. Addressing this question has thus far been hampered by a tendency for researchers to use different tasks with different age groups. However, recently important steps have been taken towards designing tasks that can be used across a wide age range (Essa et al., in press; Horowitz, 2003; van Schaik & Hunnius, 2018). Deploying these tasks across development will help determine whether there are predictable peaks in the use of social imitation in particular developmental periods. For example, Nadel (2002) has suggested that children may be particularly likely to use social imitation in order to communicate with peers in the second year of life prior to developing sophisticated language abilities. Another possible peak in social imitation could occur in early adolescence when social pressures to conform and fit in with the group appear to be particularly salient (Landsbaum & Willis, 1971).

Once the structure and developmental trajectory of social imitation are better understood, it will be possible to investigate how the tendency to imitate for social reasons develops. We know from previous research that imitation is influenced by social factors at least from 18 months (Nielsen, 2006). However, relatively little empirical research has been directed towards understanding the types of social experiences that encourage children to modulate their imitation in social settings (Heyes,

2018). Future research could helpfully investigate the ways in which children are reinforced for imitating and how these social experiences interact with individual differences in social motivation.

Concluding summary

From early in development, children's imitation is modulated by social factors (Nielsen, 2009; Over & Carpenter, 2012; Užgiris, 1981; 1984). For example, children as young as two are more likely to imitate socially responsive and engaged models than they are to imitate uninterested or aloof models (Nielsen, 2006; Nielsen et al., 2008). Furthermore, somewhat older children tend to imitate a model more faithfully when they have a motivation to affiliate with them (Over & Carpenter, 2009; Watson-Jones et al., 2016). Convergent evidence that imitation serves social functions comes from research investigating how children respond to being imitated. Children are more likely to pay attention to, help and trust a social partner who imitates them over a social partner who engages in equally contingent but non-imitative actions (Carpenter, et al 2013; Meltzoff 1990; Over et al., 2013). Related to these findings, further research has shown that children infer the nature of third party relationships, for example who is affiliated with whom, from observing other' imitation behaviour (Over & Carpenter, 2014; Liberman et al., 2018; Powell & Spelke, 2018).

In order to understand how children's imitation varies with social context, it is important to investigate the pressures children experience within social settings as well as their own goals to affiliate (Over & Carpenter, 2012; 2013). Research has shown that children imitate more closely when they have seen the same action demonstrated by multiple models and when they believe that the demonstrated actions represent a social convention (Clay et al., 2018; Corriveau et al., 2009; Herrmann et al., 2013). These social pressures to imitate are particularly salient when members of the community are present to observe their imitation (Nielsen & Blank, 2011, see also Haun & Tomasello, 2011).

Imitation shapes how cultures emerge but it is also shaped by culture (Heyes, 2018). Recent research has demonstrated that there are

systematic cultural differences in the extent to which children engage in imitation in social settings (Berl & Hewlett, 2015; Corriveau et al., 2013; DiYanni et al., 2015). This research suggests that social imitation is less common in cultures with a reduced focused on formal teaching (Berl & Hewlett, 2015; Hewlett et al., 2016) and more common within cultures where self-construal is interdependent (Corriveau et al., 2013; DiYanni et al., 2015). Taken together, these findings illustrate the complex relationship between imitation, social motivation, and human unique forms of culture.

References

Asch, S.E. 1956. Studies of independence and conformity: 1. A minority of one against a unanimous majority. *Psychol Monogr, 70*.

Atlinok, N., Over, H., & Carpenter, M. *Young children use imitation communicatively.* Manuscript submitted for publication.

Barr, R., Dowden, A., & Hayne, H. 1996. Developmental changes in deferred imitation by 6- to 24-month-old infants. *Infant Behav Dev, 19*, 159-170.

Bavelas, J.B., Black, A., Lemery, C.R., & Mullett, J. 1986. "I *show* you how you feel": Motor mimicry as a communicative act. *J Pers Soc Psychol, 50*, 322-329.

Berl, R., & Hewlett, B. 2015. Cultural variation in the use of overimitation by the Aka and Ngandu of the Congo Basin. *PLOS ONE, 10,* e0120180.

Boyd, R., Richerson, P.J., & Henrich, J. 2011. The cultural niche: Why social learning is essential for human adaptation. *PNAS, 108,* 10918-10925.

Buttelmann, D., Zmyj, N. & Carpenter, M. 2013. Selective imitation of in-group and out-group members in 14-month-old infants. *Child Dev, 84,* 422-428.

Carpenter, M., Akhtar, N., & Tomasello, M. 1998. Fourteen- to 18- month-old infants differentially imitate intentional and accidental actions. *Infant Behav Dev, 21,* 315–330.

Carpenter, M., & Call, J. 2002. The chemistry of social learning. *Dev Sci, 5,* 22-24.

Carpenter, M., Uebel, J., & Tomasello, M. 2013. Being mimicked increases prosocial behavior in 18-month-old infants. *Child Dev, 84,* 1511-18.

Chartrand, T.L., & Bargh, J.A. 1999. The chameleon effect: The perception-behavior link and social interaction. *J Pers Soc Psychol, 76,* 893-910.

Chartrand, T.L., & van Baaren, R. 2009. Human mimicry. *Adv Exp Soc Psychol, 41,* 219-274.

Chevallier, C., Kohls, G., Troiani, V., Brodkin, E.S., & Schultz, R.T. 2012. The social motivation theory of Autism. *TICS*, *16,* 231-239.

Chevallier, C., Molesworth, C. & Happé, F. 2012. Diminished social motivation negatively impacts reputation management: Autism Spectrum Disorders as a Case in Point. *PLOS ONE, 7*, e31107.

Chevallier, C., Grèzes, J., Molesworth, C., Berthoz, S. & Happé, F. 2012. Selective social anhedonia in high functioning autism. *J Autism Dev Disord, 42,*1504-9.

Cialdini, R. B. 2001. *Influence: Science and practice.* Boston, MA: Allyn & Bacon.

Clay, Z., Over, H. & Tennie, C. 2018. What drives young children to over-imitate? Investigating the effects of age, context, action type, and transitivity. *J Expl Child Psychol, 166,* 520-534.

Clay, Z. & Tennie, C. 2018. Is overimitation a uniquely human phenomenon? Insights from human children as compared to Bonobos. *Child Dev, 89,* 1535-1544.

Clegg, J.M., & Legare, C.H. 2016. A cross-cultural comparison of children's imitative flexibility. *Dev Psychol, 52,* 1435-1444.

Corriveau, K.H., Fusaro, M. & Harris, P.L. 2009. Going with the flow: Preschoolers prefer non-dissenters as informants. *Psychol Sci, 20,* 372-377.

Corriveau, K.H., DiYanni, C.J., Clegg, J.M., Min, G., Chin, J., & Nasrini, J. 2017. Cultural differences in the imitation and transmission of inefficient actions, *J Exp Child Psychol, 161,* 1-18.

Corriveau, K.H., Kim, E., Song, G. & Harris, P.L. 2013. Young children's deference to a majority varies by culture. *J Cognit Cult, 13,* 367-381.

Deutsch, M., & Gerard, H.B. 1955. A study of normative and informational social influences upon individual judgment. *J Abnor Soc Psych, 51,* 629-636.

DiYanni, C. J., Corriveau, K. H., Kurkul, K., Nasrini, J., & Nini, D. 2015. The role of consensus and culture in children's imitation of inefficient actions. *J Exp Child Psychol, 137,* 99–110.

Dunham, Y., Baron, A. S., & Carey, S. 2011. Consequences of "minimal" group affiliations in children. *Child Dev*, *82*, 793–811.

Essa, F. Sebanz, N., & Diesendruck, G. in press. The automaticity of children's imitative group bias. *Cogn Dev.*

Fusaro, M., & Harris, P. L. 2008. Children assess informant reliability using bystanders' non-verbal cues. *Dev Sci, 11,* 771–777.

Fusaro, M., & Harris. P.L. 2008. Children assess informant reliability using bystanders' non-verbal cues. *Dev Sci, 11,* 771-777.

Georgiades, S., Szatmari, P., & Boyle, M. 2013. Importance of studying heterogeneity in autism. *Neuropsychiatry, 3,* 123– 125.

Gergely, G. & Csibra, G. 2006. Sylvia's recipe: The role of imitation and pedagogy in the transmission of human culture. In N. J. Enfield & S. C. Levinson (Eds.), *Roots of human sociality: Culture, cognition, and human interaction* (pp. 229-255). Oxford, UK: Berg Publishers.

Haun, D.B.M., Rekers, Y., & Tomasello, M. 2014. Children conform to the behaviour of peers; other great apes stick with what they know. *Psychol Sci, 25,* 2160-2167.

Haun, D.B.M., & Over, H., 2013. Like me: A homophily-based account of human culture. In P.J. Richerson, and M. Christiansen, (Eds). *Cultural evolution.* Cambridge, MA, USA: MIT Press.

Haun, D. B. M., & Tomasello, M. 2011. Conformity to peer pressure in preschool children. *Child Dev, 82,* 1759-1767.

Hare, B., & Kwentuensa, S. 2010. Bonobos voluntarily share their own food with others. *Curr Biol, 20,* R230-R231.

Hermann, E., Hare, B., Call, J., & Tomasello, M. 2010. Differences in the cognitive skills of Bonobos and Chimpanzees. *PLOS ONE, 5,* e.12438.

Herrmann, P. A., Legare, C. H., Harris, P. L., & Whitehouse, H. 2013. Stick to the script: The effect of witnessing multiple actors on children's imitation. *Cognition, 129,* 536–543.

Hewlett, B. S., Berl, R. E., & Roulette, C. J. 2016. *Teaching and overimitation among aka hunter-gatherers.* In H. Terashima, & B. S. Hewlett (Eds.). Social learning and innovation in contemporary hunter-gatherers. Japan: Springer, pp. 35-45.

Hermann, P.A., Legare, C.H., Harris, P.L., & Whitehouse, H. 2013. Stick to the script: The effect of witnessing multiple actors on children's imitation. *Cognition, 129,* 536-543.

Heyes, C.M. 2018. Cognitive gadgets: The cultural evolution of thinking. Cambridge, MA: Harvard University Press.

Heyes, C.M. 2011. Automatic imitation. *Psychol Bull, 137,* 463-483.

Heyes, C.M. 2001. Causes and consequences of imitation. *TICS*, *5,* 253-261.

Hoehl, S., Keupp, S., Schleihauf, H., McGuigan, N., Buttelmann, D., & Whiten, A. 2019. "Over-imitation": A review and appraisal of a decade of research. *Develop Rev*, ***51****,* 90-108

Hobson, R.P., & Hobson, J.A. 2008. Dissociable aspects of imitation: A study in autism. *Journal of Experimental Child Psychology, 101,* 170-185.

Hobson, R.P., & Lee, A. 1999. Imitation and identification in autism. *J Child Psychol Psychiatry, 40,* 649-659.

Horner, V., & Whiten, A. 2005. Causal knowledge and imitation/emulation switching in chimpanzees (*Pan troglodytes*) and children (*Homo sapiens*). *Anim Cogn, 8*, 164-81.

Horowitz, A.C. 2003. Do humans ape? Or do apes human? Imitation and intention in humans (*Homo sapiens*) and other animals. *J Comp Psychol, 117*, 325-336.

Howard, L. H., Henderson, A. M., Carrazza, C., & Woodward, A. L. 2015. Infants' and young children's imitation of linguistic in-Group and out-Group informants. *Child Develop, 86,* 259–275.

Jones, J. T., Pelham, B. W., Carvallo, M., & Mirenberg, M. C. 2004. How do I love thee? Let me count the Js: Implicit egotism and interpersonal attraction. *J Pers Soc Psychol, 87,* 665–683.

Kano, F., Hirata, S., & Call, J. 2015. Social attention in the two species of Pan: Bonobos make more eye contact than chimpanzees. *PLOS ONE, 10,* e0129684.

Kenward, B. 2012. Over-imitating preschoolers believe unnecessary actions are normative and enforce their performance by a third party. *J Expl Child Psychol, 112*, 195–207.

Kenward, B., Karlsson, M., & Persson, J. 2011. Over-imitation is better explained by norm learning than by distorted causal learning. *P Roy Soc B-Biol Sci., 278,* 1239–1246.

Keupp, S., Behne, T., & Rakoczy, H. 2013. Why do children overimitate? Normativity is crucial. *J Exp Child Psychol, 116*, 392–406.

Krishnan-Barman, S. & Hamilton, A.F. de C. 2019. Adults imitate to send a social signal. *Cognition, 187,* 150-155.

Lakin, J. L., & Chartrand, T. L. 2003. Using nonconscious behavioral mimicry to create affiliation and rapport. *Psychol Sci, 14*, 334-339.

Lakin, J. L., Chartrand, T. L., & Arkin, R. M. 2008. I am too just like you: Nonconscious mimicry as an automatic behavioral response to social exclusion. *Psychol Sci, 19,* 816–822.

Lakin, J. L., Jefferis, V. E., Cheng, C. M., & Chartrand, T. L. 2003. The Chameleon Effect as social glue: Evidence for the evolutionary significance of nonconscious mimicry. *J Nonverbal Behav, 27,* 145–162.

Landsbaum, J. B., & Willis, R. H. 1971. Conformity in early and late adolescence. *Dev Psychol, 4*, 334–337.

Leighton, J., Bird, G., Orsini, C. & Heyes, C. M. 2010. Social attitudes modulate automatic imitation. *J Exp Soc Psychol*, *46,* 905-910.

Liberman, Z., Kinzler, K.D., & Woodward, A.L. 2018. The early social significance of shared ritual actions. *Cognition, 171,* 42-51.

Luncz L.V., Sirianni G., Mundry R., & Boesch C. 2018. Costly culture: differences in nut-cracking efficiency between wild chimpanzee groups. *Animal Behav, 137,* 63-73.

Lyons, D.E., Young, A.G., & Keil, F.C. 2007. The hidden structure of overimitation. *PNAS, 104,* 19751-19756.

Marsh, L., Pearson, A., Ropar, D., & Hamilton A. 2013. Children with autism do not overimitate, *Curr Biol, 23*, R266-R268.

McGuigan, N., Makinson, J., & Whiten, A. 2011. From over-imitation to super-copying: Adults imitate irrelevant aspects of tool use with higher fidelity than young children. *Br J Psychol, 102,* 1-18.

Meltzoff, A. N. 1995. Understanding the intentions of others: Re- enactment of intended acts by 18-month-old children. *Dev Psycho, 31,* 838–850.

Meltzoff, A.N. 1990. Foundations for developing a concept of self: The role of imitation in relating self to other and the value of social mirroring, social modelling, and self practice in infancy. In D. Cicchetti & M. Beeghly (Eds.), *The self in transition: Infancy to childhood* (pp. 139-164). Chicago: University of Chicago Press.

Nadel, J. 2002. Imitation and imitation recognition: functional use in preverbal infants and nonverbal children with autism. In A. N. Meltzoff & W. Prinz (Eds.), *The imitative mind: development, evolution, and brain bases* (pp. 42-62). Cambridge University Press.

Nagell, K., Olguin, R.S., & Tomasello, M. 1993. Processes of social learning in the tool use of chimpanzees (Pan troglodytes) and human children (Homo sapiens). *J Comp Psychol, 107,* 174-186.

Nielsen, M. 2018. The social glue of cumulative culture and ritual behaviour. *Child Dev Perspect, 12,* 264-268.

Nielsen, M. 2009. The imitative behavior of children and chimpanzees: A window on the transmission of cultural traditions, *Revue de primatologie, 1*.

Nielsen, M. 2006. Copying actions and copying outcomes: Social learning through the second year. *Dev Psychol, 42,* 555-565.

Nielsen, M., & Blank, C. 2011. Imitation in young children: When who gets copied is more important than what gets copied. *Dev Psychol*, *47*, 1050-1053.

Nielsen, M. & Hudry, K. 2010. Over-imitation in children with Autism and Down Syndrome. *Aust J Psychol, 62,* 67-74.

Nielsen, M., Mushin, I., Tomaselli, K., & Whiten, A. 2014. Where culture takes bold: "Overimitation" and its flexible deployment in Western, Aboriginal and Bushmen children. *Child Dev, 85,* 2169-2184.

Nielsen, M., Simcock, G., & Jenkins, L. 2008. The effect of social engagement on 24-month-olds' imitation from live and televised models. *Dev Sci, 11*, 722-731.

Nielsen, M., Slaughter, V., & Dissanayake, C. 2013. Object-directed imitation in children: Testing the social motivation hypothesis. *Autism Res, 6,* 23-32.

Nielsen, M., & Tomaselli, K. 2010. Over-imitation in Kalahari Bushman children and the origins of human cultural cognition. *Psychol Sci*, *21*, 729-736.

O'Sullivan, E.P., Bijovoet-van den Berg, S., & Caldwell, C.A. 2018. Automatic imitation effects are influenced by experience of synchronous action in children. *J Exp Child Psychol, 171,* 113-130.

Over, H., & Carpenter, M. 2009. Priming third-party ostracism increases affiliative imitation in children. *Dev Sci, 12*, F1-F8.

Over, H., & Carpenter, M**.** 2012. Putting the social into social learning: Explaining both selectivity and fidelity in children's copying behavior. *J Comp Psychol, 126, 182-192.*

Over, H., & Carpenter, M. 2013. The social side of imitation. *Child Devel Perspect, 7,* 6-11.

Over, H., & Carpenter, M. 2015. Children infer friendship and status relations from watching others imitate. *Dev Sci, 18,* 917-925*.*

Over, H., Carpenter, M., Spears, R., & Gattis, M. 2013. Children selectively trust individuals who have imitated them. *Soc Dev, 22,* 215-224.

Paukner, A., Suomi, S.J., Visalberghi, E., & Ferrari, P.F. 2009. Capuchin monkeys display affiliation toward humans who imitate them. *Science, 325,* 880–883.

Powell, L.J., & Spelke, E.S. 2018. Human infants' understanding of social imitation: Inferences of affiliation from third party observations. *Cognition, 170,* 31-48.

Rakoczy, H., Warneken, F., & Tomasello, M. 2008. The sources of normativity: Young children's awareness of the normative structure of games. *Develop Psychol, 44,* 875–881.

Schmidt, M. F. H., Rakoczy, H., & Tomasello, M. 2019. Eighteen-month- old infants correct non-conforming actions by others. *Infancy*, *24*, 613–635.

Stengelin, R., Hepach, R., & Haun, D.B.M. 2019. Being observed increases overimitation in three diverse cultures. *Dev Psychol, 55,* 2630-2636.

Tennie, C., Call, J., & Tomasello, M. 2009. Ratcheting up the ratchet: On the evolution of cumulative culture. *Philos T R Soc B, 364,* 2405–2415.

Thelen, M.H., Miller, D.J., Fehrenbach, P.A., Frautschi, N.M., & Fishbein, M.D. 1980. Imitation during play as a means of social influence. *Child Dev, 51*, 918-920.

Tomasello, M. 1999. *The cultural origins of human cognition.* Cambridge, MA: Harvard University Press.

Užgiris, I.C. 1984. Imitation in infancy: Its interpersonal aspects. In M. Perlmutter (Ed.), *The Minnesota symposia on child psychology: Vol. 17. Parent-child interactions and parent-child relations in child development* (pp. 1-32). Hillsdale, NJ: Erlbaum.

Užgiris, I. C. 1981. Two functions of imitation during infancy. *International J Behav Dev, 4,* 1-12.

van Leeuwen, E. J. C., Cronin, K. A., & Haun, D. B. M. 2014. A group-specific arbitrary tradition in chimpanzees (Pan troglodytes). *Animal Cognit, 17,* 1421-1425.

van Schaik, J.E., & Hunnius, S. 2018. Modulating mimicry: Exploring the roles of inhibitory control and social understanding in 5-year-olds' behavioural mimicry. *PLOS ONE, 13,* e0194102.

Watson-Jones, R.E., & Legare, C.H. 2016. The functions of ritual in social groups. *Behav Brain Sci,* 39, e26.

Watson-Jones, R. E., Legare, C. H., Whitehouse, H., & Clegg, J. M. 2014. Task-specific effects of ostracism on imitation in early childhood. *Evol Hum Behav, 35*, 204-210.

Watson-Jones, R. E., Legare, C. H., & Whitehouse, H. 2016. In-group ostracism increases high fidelity imitation in early childhood. *Psychol Sci, 27*, 34-42.

Whiten, E., & Whiten, A. 2010. Studying children's social learning experimentally "in the wild". *Learn Behav, 38,* 284-296.

Williams, K. D. 2001. *Ostracism: The power of silence.* New York: Guilford Publications.

Yu, Y., & Kushnir, T. 2014. Social context effects in 2- and 4-year-olds' selective versus faithful imitation. *Dev Psychol, 50*, 922–933.